

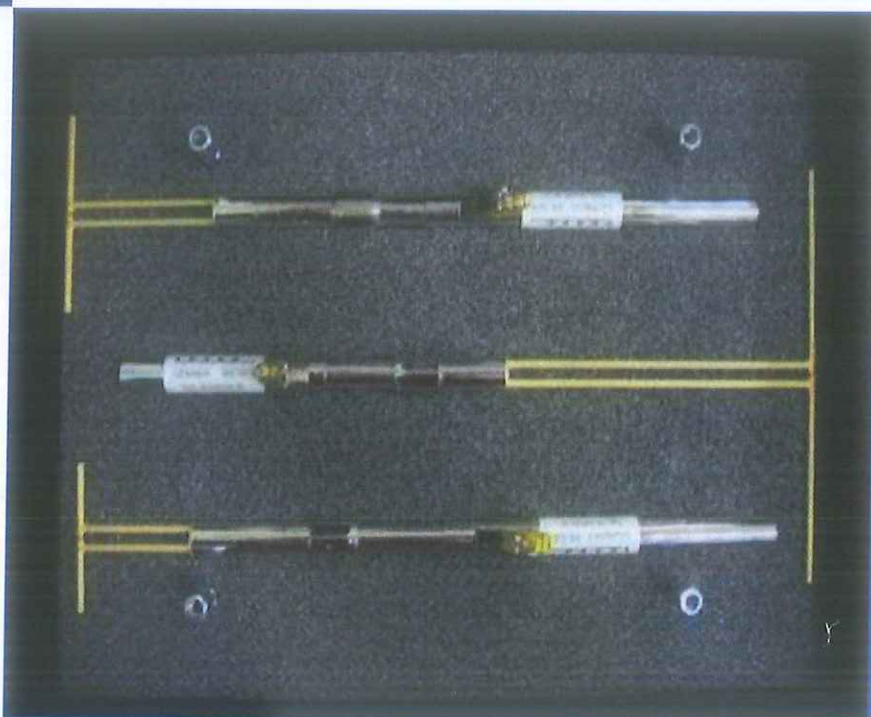
# SAR Dipole

## Performance Measurement Report

ISSUED BY  
Shenzhen BALUN Technology Co., Ltd.



FOR  
Validation Dipoles



Tested by:

Zong Liao  
(Engineer)

Approved by:

Wen Pingquan  
(Chief Engineer)

Report No.: LW-SZ1830061-701  
EUT Type: SAR Validation Dipole  
Model Name: D2450V2

Brand Name: Speag

Test Conclusion: Pass  
Test Date: Mar. 16, 2018  
Date of Issue: Mar. 18, 2016

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# 1 GENERAL INFORMATION

## 1.1 Introduction

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDB 865664 D01 for reference dipoles used for SAR measurement system validations. Instead of the typical annual calibration recommended by measurement standards, the reference dipoles were demonstrated that the SAR target, impedance and return loss have remain stable, so the longer calibration interval is acceptable.

## 1.2 General Description for Equipment under Test (EUT)

|              |                           |
|--------------|---------------------------|
| EUT Type     | DASY 52 Reference Dipoles |
| Manufacturer | Speag                     |

| Parameter                     | EUT 1      |
|-------------------------------|------------|
| Model                         | D2450V2    |
| Frequency                     | 2450 MHz   |
| Serial Number                 | SN 952     |
| Product Condition (New/ Used) | Used       |
| Last Cal. Date                | 2017/03/21 |
| Current meas. Date            | 2018/03/16 |



### 1.3 Test Equipment List

| Description                  | Manufacturer | Model     | Serial No.      | Cal. Date  | Cal. Due   |
|------------------------------|--------------|-----------|-----------------|------------|------------|
| PC                           | Dell         | N/A       | N/A             | N/A        | N/A        |
| E-Field Probe                | Speag        | ES3DV3    | SN: 3110        | 2017/08/02 | 2018/08/01 |
| Data Acquisition Electronics | Speag        | DAE4      | SN: 685         | 2017/08/02 | 2018/08/01 |
| Signal Generator             | R&S          | SMBV100A  | 260592          | 2017/06/12 | 2018/06/11 |
| Power Meter                  | Agilent      | E4419B    | GB40201833      | 2017/11/02 | 2018/11/01 |
| Power Sensor                 | Agilent      | E9300A    | MY41498012      | 2017/11/02 | 2018/11/01 |
| Power Sensor                 | Agilent      | E9300A    | MY41499891      | 2017/11/02 | 2018/11/01 |
| Power Amplifier              | SATIMO       | 6552B     | 22374           | 2017/06/12 | 2018/06/11 |
| Network Analyzer             | R&S          | ZVL-6     | 101380          | 2017/06/12 | 2018/06/11 |
| Thermometer                  | Elitech      | RC-4HC    | N/A             | 2017/11/13 | 2018/11/12 |
| Dielectric Probe Kit         | SATIMO       | SCLMP     | SN 25/13 OCPG56 | N/A        | N/A        |
| Phantom1                     | Speag        | SAM       | SN: 1859        | N/A        | N/A        |
| Phantom2                     | Speag        | SAM       | SN: 1857        | N/A        | N/A        |
| Attenuator                   | COM-MW       | ZA-S1-31  | 1305003187      | N/A        | N/A        |
| Directional coupler          | AA-MCS       | AAMCS-UDC | 000272          | N/A        | N/A        |

## 1.4 EUT Photos





## 2 SIMULATING LIQUID VERIFICATION

| Liquid Type | Fre. (MHz) | Meas. Conductivity ( $\sigma$ ) (S/m) | Meas. Permittivity ( $\epsilon$ ) | Target Conductivity ( $\sigma$ ) (S/m) | Target Permittivity ( $\epsilon$ ) | Conductivity Tolerance (%) | Permittivity Tolerance (%) |
|-------------|------------|---------------------------------------|-----------------------------------|----------------------------------------|------------------------------------|----------------------------|----------------------------|
| Head        | 2450       | 1.84                                  | 38.94                             | 1.80                                   | 39.20                              | 2.22                       | -0.66                      |
| Body        | 2450       | 1.93                                  | 50.88                             | 1.95                                   | 52.70                              | -1.03                      | -3.45                      |



### 3 DIPOLE IMPEDANCE AND RETURN LOSS

The dipoles are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyser was used to perform a return loss measurement on the specific dipole when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyser.

The measurement of verification with return loss should not deviate by more than 20% and minimum of 20 dB of the return loss, and the impedance (real or imaginary parts) should not deviate by more than 5 Ohms from the previous measurement using network analyzer.

Note:

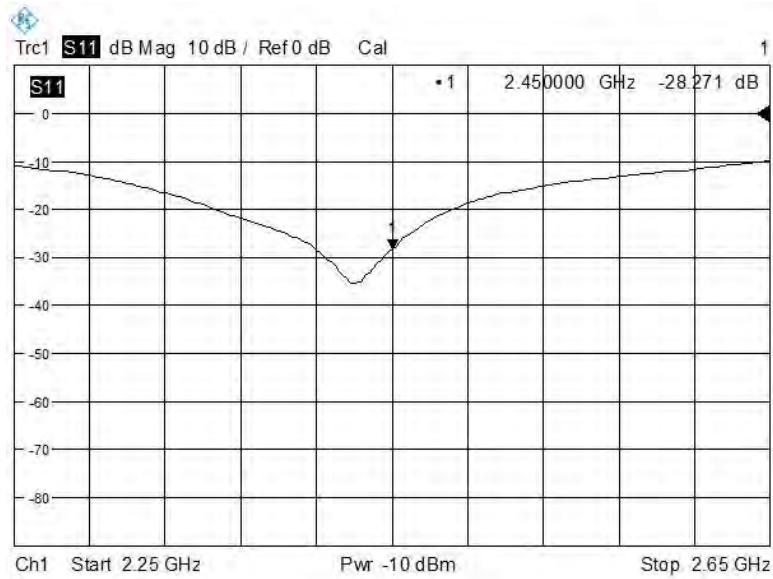
The "Previous Meas." in the following table refer to dipoles or other equivalent RF sources calibration reports.

### 3.1 D2450V2

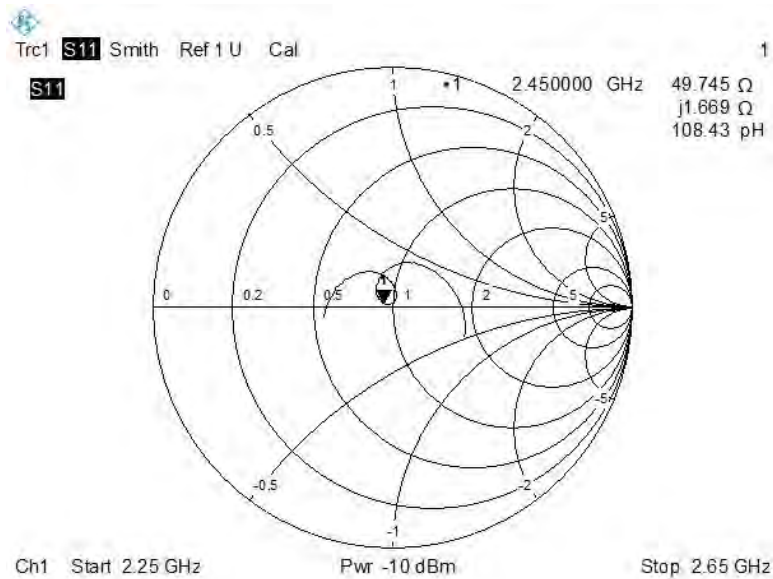
#### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results    | Current Meas.                    | Previous Meas.                   | Max. Deviation                     |
|------------------|----------------------------------|----------------------------------|------------------------------------|
| Return Loss (dB) | -28.271                          | -24.261                          | 16.5%                              |
| Impedance        | 49.7 $\Omega$ + 1.669 j $\Omega$ | 52.0 $\Omega$ + 5.937 j $\Omega$ | 4.268 $\Omega$<br>(Imaginary part) |

#### Return Loss



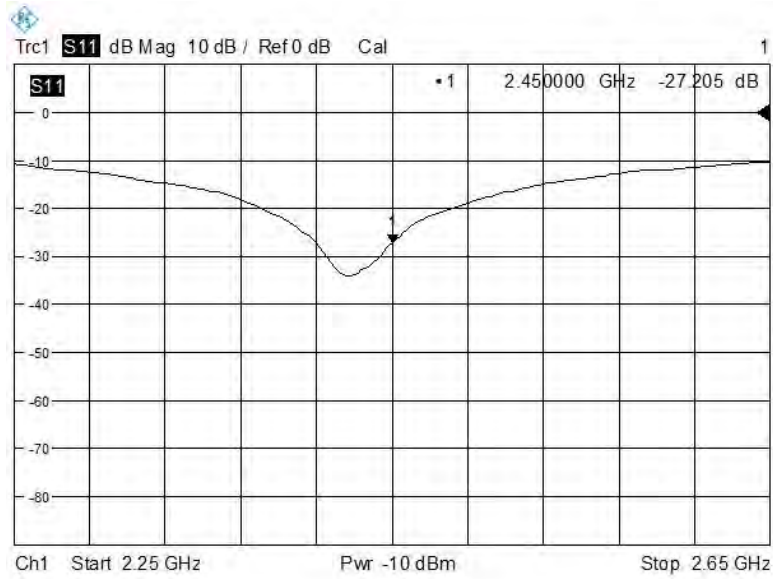
#### Impedance



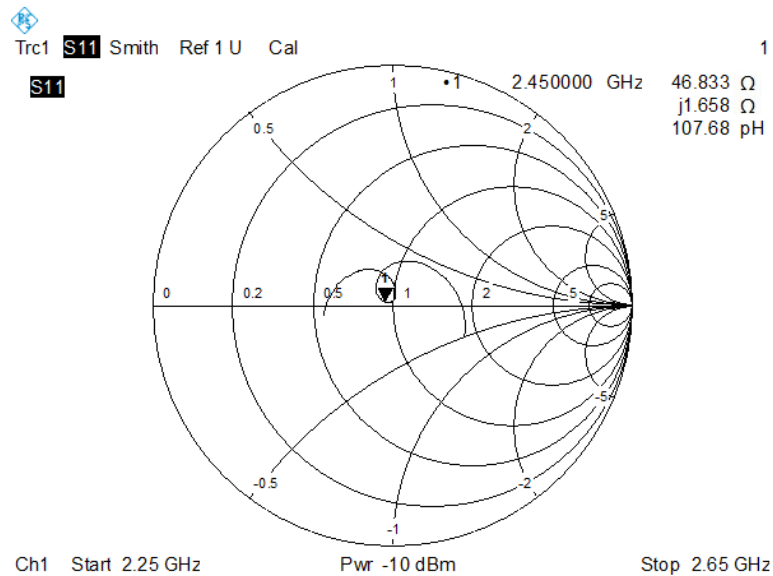
## RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Meas. Results    | Current Meas.                    | Previous Meas.                   | Max. Deviation                     |
|------------------|----------------------------------|----------------------------------|------------------------------------|
| Return Loss (dB) | -27.205                          | -23.809                          | 14.3%                              |
| Impedance        | 46.8 $\Omega$ + 1.658 j $\Omega$ | 48.7 $\Omega$ + 6.254 j $\Omega$ | 4.596 $\Omega$<br>(Imaginary part) |

### Return Loss

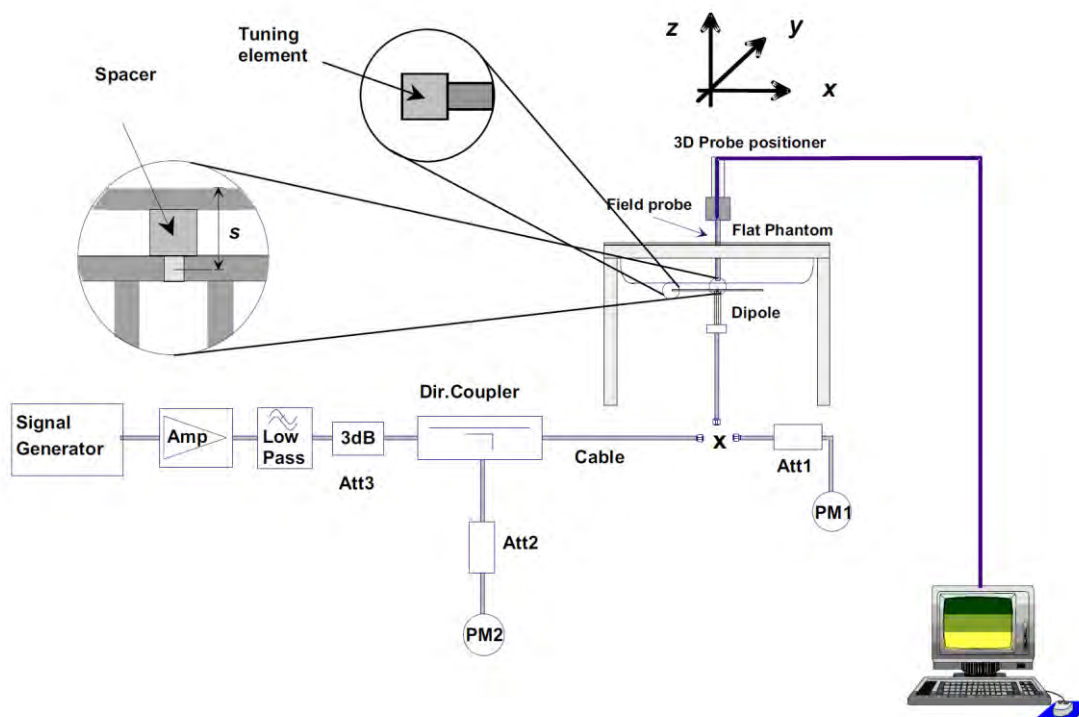


### +Impedance



## 4 VALIDATION MEASUREMENT

The IEEE Std. 1528, FCC KDBs and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.





## 4.1 Dipole SAR Validation Measurement Result

| Freq.<br>(MHz) | Liquid<br>Type | Power<br>(mW) | 1 g<br>Measured<br>SAR<br>(W/kg) | Normaliz<br>ed SAR<br>(W/kg) | 10 g<br>Measured<br>SAR<br>(W/kg) | Normaliz<br>ed SAR<br>(W/kg) | 1 g<br>Targeted<br>SAR<br>(W/kg) | Tolerance<br>(%) | 10 g<br>Targeted<br>SAR<br>(W/kg) | Tolerance<br>(%) |
|----------------|----------------|---------------|----------------------------------|------------------------------|-----------------------------------|------------------------------|----------------------------------|------------------|-----------------------------------|------------------|
| 2450           | Head           | 100           | 5.390                            | 54.39                        | 2.380                             | 23.80                        | 52.40                            | 2.86             | 24.00                             | -0.83            |
|                | Body           | 100           | 5.310                            | 53.10                        | 2.290                             | 22.90                        | 52.40                            | 1.34             | 24.00                             | -4.58            |

## 4.2 D2450V2

### 4.2.1 Dipole 2450 MHz Validation Measurement for Head Tissue

**Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2-SN: 952**

Date/Time: 03/16/2018

Communication System Band: CD2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.84$  S/m;  $\epsilon_r = 38.94$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.5 Liquid Temperature: 21.3

DASY5 Configuration:

- Probe: ES3DV3 - SN3110; ConvF(4.4, 4.4, 4.4);
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685;
- Phantom: SAM (30deg probe tilt) with CRP v5.0 Right 1857; Type: QD000P40CD; Serial: TP1857
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Dipole validation measurement for Head Tissue/ Pin= 100mW ,d=10mm /Zoom**

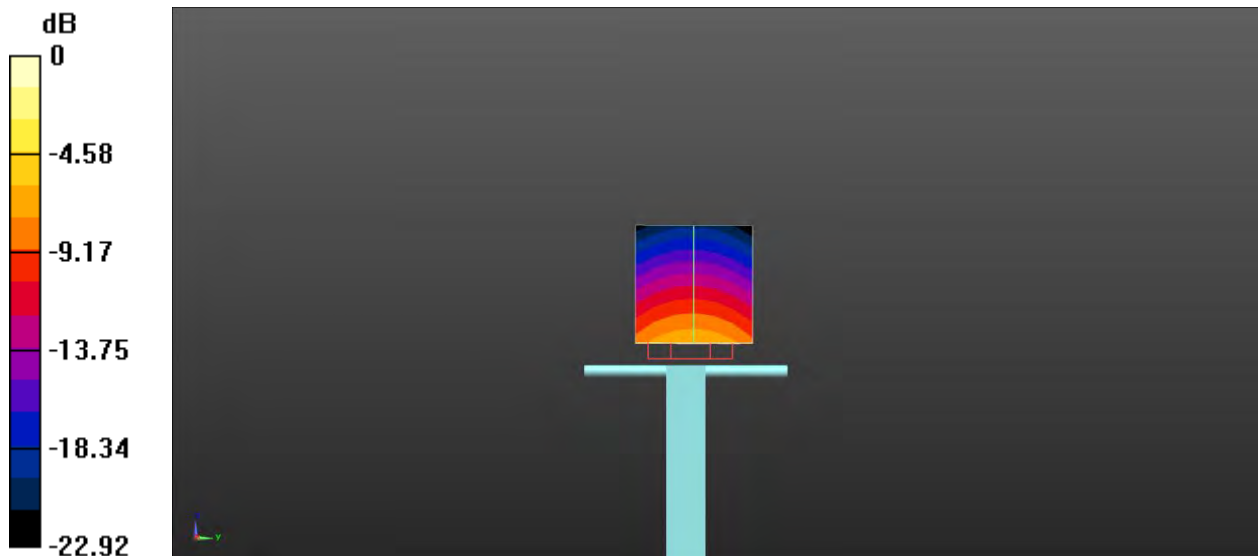
**Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.28 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 11.8 W/kg

**SAR(1 g) = 5.39 W/kg; SAR(10 g) = 2.38 W/kg**

Maximum value of SAR (measured) = 6.21 W/kg



0 dB = 6.21 W/kg



#### 4.2.2 Dipole 2450 MHz Validation Measurement for Body Tissue

**Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2-SN: 952**

Date/Time: 03/16/2018

Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.93$  S/m;  $\epsilon_r = 50.88$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Ambient Temperature: 22.5 Liquid Temperature: 21.3

DASY5 Configuration:

- Probe: ES3DV3 - SN3110; ConvF(4.23, 4.23, 4.23);
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685;
- Phantom: SAM (30deg probe tilt) with CRP v5.0 on left 1859; Type: QD000P40CD; Serial: TP1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

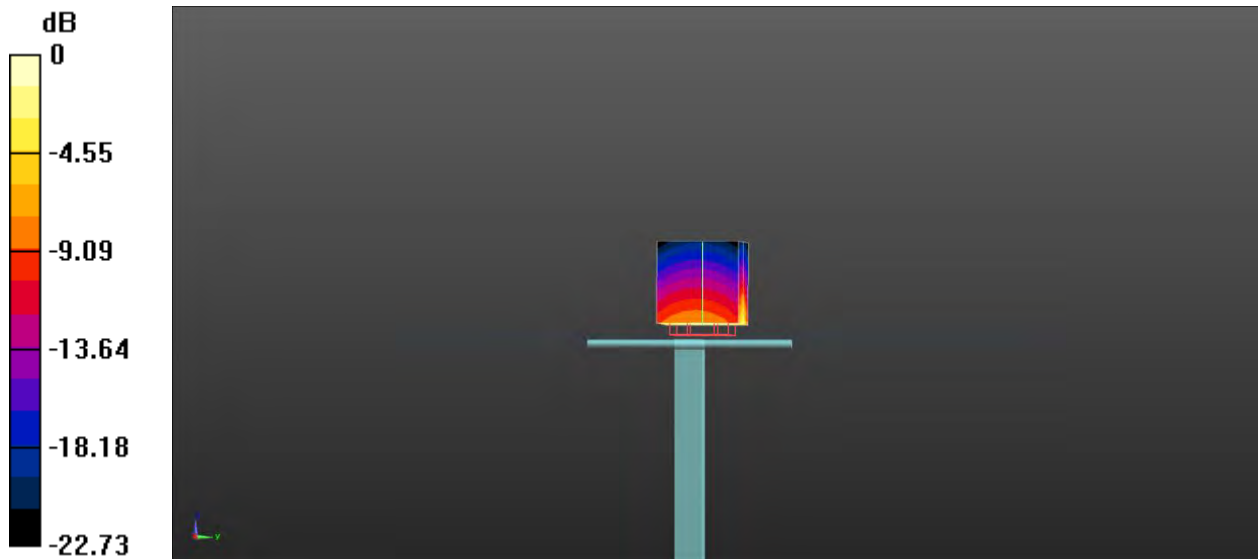
**Dipole validation measurement for Body Tissue/Pin= 100mW ,d=10mm /Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 49.11 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 10.9 W/kg

**SAR(1 g) = 5.31 W/kg; SAR(10 g) = 2.29 W/kg**

Maximum value of SAR (measured) = 5.92 W/kg



0 dB = 5.92 W/kg

--END OF REPORT--